

We Claim:

1. A system for determining a fault condition in an infusion system including an infusion pump capable of infusing fluid from a primary container connected to a primary infusion line and a secondary container connected to the primary infusion line through a secondary infusion line, the secondary infusion line having a valve to control flow of the secondary fluid in the secondary fluid line, the primary infusion line having a check valve disposed between the primary container and the connection of the secondary infusion line to the primary infusion line, the check valve for prevent flow backwards from the primary infusion line into the primary container, comprising:

a pressure sensor disposed adjacent the primary infusion line below the connection of the secondary infusion line to the primary infusion line, the pressure sensor in operative arrangement with the primary infusion line to measure pressure within the primary infusion line, the pressure sensor providing signals representative of the pressure within the primary infusion line;

a memory for storing pressure related values;

a processor in communication with the memory and responsive to the signals provided by the pressure sensor, the processor programmed to sample the pressure signals, establish a baseline pressure value, store the baseline pressure value in the memory, compare the baseline pressure value with pressure values sampled at a latter time, and if the latter sampled pressure value equals or is greater than a selected threshold pressure value, provide an alert that a fault condition exists.

2. The system of claim 1 wherein the processor determines if the time of the latter sampled pressure value is within a measurement window before comparing the latter sampled pressure value to the threshold pressure value.

3. The system of claim 2 wherein the measurement window has a start boundary and an end boundary, and if the latter sampled pressure value has been sampled at a time within the start and end boundaries, and the latter sampled pressure value is equal to or greater than the selected pressure value, the alert is provided.

4. The system of claim 1 wherein the processor is further programmed to operate the infusion pump in a reverse mode to inject a bolus of fluid into the primary infusion line after establishing the baseline pressure value.

5. The system of claim 1 wherein the processor is programmed to operate the infusion pump in a reverse mode to inject a bolus of fluid into the primary infusion line if the latter sampled pressure value is less than the selected threshold pressure value.

6. The system of claim 5 wherein the processor is programmed to sample the pressure signals received from the pressure sensor after operating the infusion pump in the reverse mode, and analyze the pressure signals to determine a characteristic of a pressure wave represented by the pressure signals, and compare that characteristic with a baseline characteristic of the stored baseline pressure value, and if the characteristic is equal to or greater than a selected threshold, provide an alert indicating that a fault condition exists.

7. The system of claim 6 wherein if the characteristic is less than the selected threshold, provide a check set up alert to a care-giver.

8. A system for determining a fault condition in an infusion system including an infusion pump capable of infusing fluid from a primary container connected to a primary infusion line and a secondary container connected to the primary infusion line through a secondary infusion line, the secondary infusion line having a valve to control flow of the secondary fluid in the secondary fluid line, the primary infusion line having a check valve disposed between the primary container and the connection of the secondary infusion line to the primary infusion line, the check valve for prevent flow backwards from the primary infusion line into the primary container, comprising:

a pressure sensor disposed adjacent the primary infusion line below the connection of the secondary infusion line to the primary infusion line, the pressure sensor in operative arrangement with the primary infusion line to measure pressure within the primary infusion line, the pressure sensor providing signals representative of the pressure within the primary infusion line;

a memory for storing pressure related values;

a processor in communication with the memory and responsive to the signals provided by the pressure sensor, the processor programmed to sample the pressure signals, establish a

baseline pressure value, store the baseline pressure value in the memory, operate the infusion pump to increase the pressure in the primary infusion line, sample the pressure signals after operating the pump to increase the pressure in the primary infusion line, compare the baseline pressure value with pressure values sampled after operating the pump to increase the pressure in the primary infusion line, and if the latter sampled pressure value equals or is greater than a selected threshold pressure value, provide an alert that a fault condition exists.

9. The system of claim 8 wherein the processor operates the pump in a reverse mode to increase the pressure in the primary infusion line.

10. The system of claim 9 further comprising a controllable device for applying pressure to the primary infusion line, the device disposed between an intake of the infusion pump and the connector connecting the secondary infusion line to the primary infusion line.

11. The system of claim 10 wherein the controllable device is responsive to signals from the processor to apply pressure to the primary infusion line.

12. A method of determining whether a valve in a secondary infusion line is open during a secondary infusion; comprising:

sampling pressure signals provided by a pressure sensor in operable communication with an upstream infusion line;

establishing a baseline pressure from the sampled pressure signals;

storing the baseline pressure in a memory;

sampling further pressure signals after establishing the baseline pressure;

comparing the further sampled pressure to the baseline pressure;

providing an alert if a further sampled pressure value is equal to or greater than a threshold pressure.

13. The method of claim 12 wherein comparing the further sampled pressure to the baseline pressure includes determining if the further sampled pressure value was sampled at a time occurring within a selected measurement window having a start time and an end time.

14. The method of claim 12 further comprising:

causing an increase in the pressure within the upstream infusion line if the further sampled pressure value is less than the threshold pressure;

sampling the pressure signals after the pressure in the primary infusion line is increased;

comparing a characteristic of the pressure signals sampled after the pressure in the primary infusion line is increased with a characteristic of the threshold pressure; and

providing an alert if the characteristic of the pressure signals is greater than or equal to the characteristic of the threshold pressure.

15. The method of claim 14 wherein sampling the pressure signals after the pressure is increased includes integrating the characteristic with respect to the baseline pressure; and comparing the integrated characteristic with the characteristic of the threshold pressure.

16. A method for determining the status of a secondary infusion; comprising:
sampling pressure signals provided by a pressure sensor in operable communication with an upstream infusion line;

establishing a baseline pressure from the sampled pressure signals;

storing the baseline pressure in a memory;

causing an increase in the pressure within the upstream infusion line;

sampling the pressure signals after the pressure in the primary infusion line is increased;

comparing a characteristic of the pressure signals sampled after the pressure in the primary infusion line is increased with a characteristic of the threshold pressure; and

providing an alert if the characteristic of the pressure signals is greater than or equal to the characteristic of the threshold pressure.

17. The method of claim 16 wherein causing an increase in the pressure within the upstream infusion line includes operating an infusion pump in a reverse mode.

18. The method of claim 16 wherein causing an increase in the pressure within the upstream infusion line includes controlling a device to increase the pressure within the upstream infusion line.

19. The method of claim 18 wherein the device is an electromechanical actuator and increasing the pressure within the upstream infusion line includes controlling the electromechanical actuator to squeeze and release the upstream infusion line.